



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--------------------------------------|-------------|----------------------|---------------------|------------------|
| 10/730,940 | 12/10/2003 | Bi O. Lim | 040044-0307075 | 6292 |
| 909 | 7590 | 06/28/2005 | EXAMINER | |
| PILLSBURY WINTHROP SHAW PITTMAN, LLP | | | LUU, CHUONG A | |
| P.O. BOX 10500 | | | ART UNIT | |
| MCLEAN, VA 22102 | | | PAPER NUMBER | |
| | | | 2818 | |

DATE MAILED: 06/28/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|-----------------|--------------|--|
| Office Action Summary | Application No. | Applicant(s) | |
| | 10/730,940 | LIM, BI O. | |
| | Examiner | Art Unit | |
| | Chuong A. Luu | 2818 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 April 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Arguments

Applicant's arguments with respect to claims 1-16 have been considered but are moot in view of the new ground(s) of rejection.

WITHDRAWN

The indicated allowability of claims 5-16 is withdrawn in view of the newly discovered reference(s) to Satta et al. (U.S. 6,391,785 B1) and Kang et al. (U.S. 6,139,700). Rejections based on the newly cited reference(s) follow.

PRIOR ART REJECTIONS

Statutory Basis

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The Rejections

Claims 1-4, 7 and 9 are rejected under 35 U.S.C. 102(e) as being anticipated by Satta et al. (U.S. 6,391,785 B1).

Satta discloses a method of manufacturing a dual damascene structure with

- (1) forming an insulating layer (14, 15) on a semiconductor substrate;
- forming a contact hole (22) on the insulating layer (14, 15);
- depositing a barrier metal layer (26) in the contact hole (22) and on the insulating layer (14, 15) using an atomic layer deposition process (see column 5, lines 10-30; column 7, lines 40-46);
- performing the atomic layer deposition process a plurality of times to produce a barrier metal layer having a desired thickness (see column 10, lines 35-39)
- (2) wherein the barrier metal layer is a tungsten nitride (see column 7, lines 40-46);
- (3) performing a deposition process to deposit a tungsten layer to fill the contact hole (see column 3, lines 34-37. Figures 1-2);
- (4) wherein the barrier metal layer is a tungsten nitride layer (see column 7, lines 40-46);
- (7) wherein the reaction chamber is maintained at a pressure of 10 to 350 Torr (see column 12, lines 5-11);
- (9) wherein said depositing the tungsten nitride layer comprises: depositing a silicon single atomic layer in the contact hole; forming a tungsten single atomic layer; forming the tungsten nitride layer by plasma-processing the tungsten single atomic layer (see column 5, lines 10-30; column 7, lines 40-46. Figures 1-2).

PRIOR ART REJECTIONS

Statutory Basis

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The Rejections

Claims 5-6, 8 and 10-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Satta et al. (U.S. 6,391,785 B1) in view of Kang et al. (U.S. 6,139,700).

Satta discloses a method of manufacturing a dual damascene structure with **(8)** wherein the reaction chamber is maintained at a temperature of 350 to 400°C (250 to 500°C) (see column 12, lines 5-11);

(15); (16) wherein the barrier layer has a total thickness of less than 200 Å (3 to 100Å) (see column 10, lines 35-45).

Satta teaches the above outlined features except for the specific reaction chamber operational conditions, reactant gases parameters and thickness of the barrier layer. However, Kang discloses a method of fabricating a metal interconnection device with **(5)** wherein the tungsten nitride layer and the tungsten layer are in-situ deposited in a reaction chamber (see column 2, lines 35-37); **(6)** wherein the tungsten nitride layer and the tungsten layer are in-situ deposited in a reaction chamber for depositing the

Art Unit: 2818

tungsten layer (see column 2, lines 35-67); **(10)** wherein the silicon single atomic layer is deposited using SiH_4 gas (see column 4, lines 15-20); **(11)** wherein the SiH_4 gas is injected at a flow rate of 5 to 200 SCCM; **(12)** wherein the tungsten single atomic layer is formed using WF_6 gas, wherein the silicon of the silicon single atomic layer reacts with WF_6 gas; **(13)** wherein the WF_6 gas is injected at a flow rate of 5 to 200 SCCM (see column 6, lines 4-51); **(14)** wherein the tungsten nitride layer is formed by plasma-processing the tungsten single atomic layer using nitrogen gas (see column 2, lines 35-67). The specific reaction chamber operational conditions, reactant gases parameters and thickness of the barrier layer are considered to be obvious. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Satta's device (in accordance with the teaching of Kang) within the range as claimed for the purpose of obtaining the better performance, and it also has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art and it is noted that the applicant does not disclose criticality in the ranges claimed. In re Aller, 105 USPQ 233 (see MPEP 2144.05).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chuong A. Luu whose telephone number is (571) 272-1902. The examiner can normally be reached on M-F (6:15-2:45).

Art Unit: 2818

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David C. Nelms can be reached on (571) 272-1787. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Chuong Anh Luu
Patent Examiner
June 24, 2005